

Gravity and Solar System

Talk to a Teacher

<http://spoken-tutorial.org>

National Mission on Education through ICT

<http://sakshat.ac.in>

Meenal Ghoderao

IIT Bombay

16 March 2018



Learning Objectives



Learning Objectives

- ▶ Demonstrate **Gravity and Orbits** and **My Solar System**, PhET simulations



System Requirement



System Requirement

- ▶ **Ubuntu Linux OS v 14.04**



System Requirement

- ▶ **Ubuntu Linux OS v 14.04**
- ▶ **Java v 1.7.0**



System Requirement

- ▶ **Ubuntu Linux OS v 14.04**
- ▶ **Java v 1.7.0**
- ▶ **Firefox Web Browser v 53.02.2**



Pre-requisites



Pre-requisites

- ▶ **Learner should be familiar with topics in high school science**



Learning Goals



Learning Goals

- ▶ Describe the relation between Sun, Earth, Moon and Satellite



Learning Goals

- ▶ Describe the relation between Sun, Earth, Moon and Satellite
- ▶ Study the effect of mass and distance on gravitational force



Learning Goals

- ▶ Describe the relation between Sun, Earth, Moon and Satellite
- ▶ Study the effect of mass and distance on gravitational force
- ▶ Explain how gravity controls the motion of our solar system



Learning Goals



Learning Goals

- **Identify the variables that affect the strength of gravity**



Learning Goals

- ▶ Identify the variables that affect the strength of gravity
- ▶ Determine the gravitational force



Solar System



Solar System

- ▶ In our solar system, all the celestial objects revolve around the Sun



Solar System

- ▶ In our solar system, all the celestial objects revolve around the Sun
- ▶ These objects are planets, moons, comets, asteroids, meteors and meteorites



Gravitational Force



Gravitational Force

- ▶ **There exists a force of attraction between the Sun and the celestial objects**

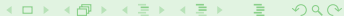


Gravitational Force

- ▶ There exists a force of attraction between the Sun and the celestial objects
- ▶ This force of attraction is gravitational force



PhET Simulation-Link



PhET Simulation-Link

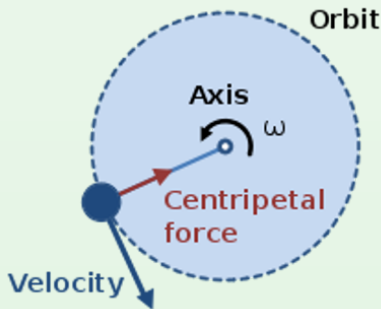
<https://phet.colorado.edu>



Centripetal Force



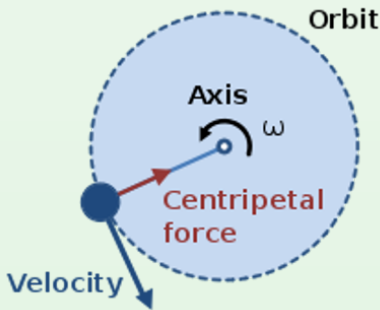
Centripetal Force



- Centripetal force causes change in acceleration and keeps the body moving along the circular path



Centripetal Force



- ▶ Centripetal force causes change in acceleration and keeps the body moving along the circular path
- ▶ This force acts towards the centre



Assignment



Assignment

Using **Model** screen,
Explore earth, moon and earth,
satellite systems



Universal Law of Gravitation



Universal Law of Gravitation

- ▶ The force of attraction between any two objects is proportional to the product of their masses



Universal Law of Gravitation

- ▶ The force of attraction between any two objects is proportional to the product of their masses
- ▶ It is inversely proportional to the square of the distance between them



Universal Law of Gravitation



Universal Law of Gravitation

- ▶ This force is along the line joining the centers of two objects



Calculation of Gravitational Force



Calculation of Gravitational Force

$$F = \frac{G \times M \times m}{d^2}$$

$$G = 6.67 \times 10^{-11} \text{ Nm}^2/\text{kg}^2$$

$$M = 1.989 \times 10^{30} \text{ kg} \quad m = 5.972 \times 10^{24} \text{ kg}$$

$$d = 91503 \times 10^3 \text{ mile} \quad 1 \text{ mile} = 1.609 \times 10^3 \text{ m}$$

$$F = \frac{[(6.67 \times 10^{-11})(1.99 \times 10^{30})(5.97 \times 10^{24})]}{[(91503 \times 10^3 \times 1.609 \times 10^3)^2]}$$

$$F = \frac{79.27 \times 10^{43}}{2.165 \times 10^{22}} \quad F = 3.6 \times 10^{22} \text{ N}$$



Assignment



Assignment

Using **To Scale** screen,
Determine the gravitational force
between Earth and satellite



Assignment



Assignment

1. Select various systems and observe the orbits
2. Change the Initial settings and observe the changes in the orbits
3. Explain the observation



Summary



Summary

- ▶ How to use Gravity and Orbits and My Solar System, PhET simulations



Summary



Summary

- ▶ Described the relation between Sun, Earth, Moon and Satellite
- ▶ Studied the effect of mass and distance on gravitational force
- ▶ Explained how gravity controls the motion of our solar system



Summary



Summary

- ▶ Identified the variables that affect the strength of gravity
- ▶ Determined the gravitational force



About the Spoken Tutorial Project

- ▶ Watch the video available at http://spoken-tutorial.org/What_is_a_Spoken_Tutorial
- ▶ It summarises the Spoken Tutorial project



About the Spoken Tutorial Project

- ▶ Watch the video available at http://spoken-tutorial.org/What_is_a_Spoken_Tutorial
- ▶ It summarises the Spoken Tutorial project
- ▶ If you do not have good bandwidth, you can download and watch it



Spoken Tutorial Workshops

The Spoken Tutorial Project Team

- ▶ Conducts workshops using spoken tutorials
- ▶ Gives certificates to those who pass an online test
- ▶ For more details, please write to contact@spoken-tutorial.org



Forum for specific questions

- ▶ Do you have questions in **THIS Spoken Tutorial?**
- ▶ Please visit
<http://forums.spoken-tutorial.org>
- ▶ Choose the minute and second where you have the question
- ▶ Explain your question briefly
- ▶ Someone from our team will answer them



Acknowledgements

- ▶ This project is partially funded by
**Pandit Madan Mohan Malaviya
National Mission on Teachers and
Teaching**



Acknowledgements

- ▶ Spoken Tutorial Project is a part of the Talk to a Teacher project
- ▶ It is supported by the National Mission on Education through ICT, MHRD, Government of India
- ▶ More information on this Mission is available at

<http://spoken-tutorial.org/NMEICT-Intro>

